United States Department of Agriculture

Soil Conservation Service

Lakewood Field Office
730 Simms Street, Room 416
Golden, CO 80401
(303) 236-2702

April 23, 1985

Chuck Illsley
Rocky Flats Plant
Energy Systems Group
P.O. Box 464
Golden, CO 80401

Dear Chuck:

Here are our final recommendations for erosion control and revegetation for the proposed remedial action project.

These are generalized recommendations; we will need to develop site-specific recommendations as individual parcels are considered for remedial action.

I have included specific information on the land presently owned by the City of Broomfield - erosion calculations, strip layout, etc..

Please, note that we have made a few changes:

1. The wind and water erosion worksheet has been adjusted to more accurately reflect erosion potential during short, but critical, periods of time during the remedial action process.
2. We have recommended a single seeding mix. This will make seed purchase easier for you. Our staff feels that if there are any changes in the mix, they should be in the direction of excluding the introduced grasses.
3. We are specifying the use of "male-sterile" forage sorghum hybrids; this will ensure that the cover crop produces no viable seed.
4. The earliest recommended fall seeding date for grass is November 1.

Please call if you have any questions.

Sincerely,

Gary D. Finstad
District Conservationist

cc: Kathy Kochevar, City of Broomfield
Al Hazle, Colorado Department of Health
U.S. District Court
Ray Printz, Jefferson County Open Space
U.S. Department of Energy, Rocky Flats Plant
Sheldon Boone, SCS, Denver
Bruce Lindahl, SCS, Greeley
Wayne Baughman, Jefferson Soil Conservation District

FINAL RECOMMENDATIONS
APRIL 23, 1985

GENERAL EROSION CONTROL AND REVEGETATION RECOMMENDATIONS
(For land areas in: S½ Sec. 6, Sec. 7, W½ Sec. 18, T. 2 S., R. 69 W.)

The Soil Conservation Service (SCS) has been requested by Rockwell International (contractor to the U.S. Department of Energy) to provide erosion control and revegetation recommendations which will help them carry out the provisions of a U.S. District Court settlement reached in 1984. The court settlement deals with the mitigation and disposition of plutonium contaminated lands near the Rocky Flats nuclear weapons plant.

SCS provides this assistance through the Jefferson Soil Conservation District (a special district formed under provisions of state law by landowner referendum in 1942). The Rocky Flats plant has been a district cooperator since 1972.

Rockwell/DOE will perform "remedial action" on certain land areas which exceed the State of Colorado's standard for plutonium concentration in the soil (2 disintegrations/minute/gram). It has been determined by DOE, Rockwell and the State Health Department that plowing, mechanical mixing and revegetation of these lands will be sufficient to dilute the plutonium levels to within the State's standards. These recommendations apply only to those lands which are subject to the proposed remedial action. Sites which cannot feasibly be plowed or which may require different remedial treatment are not included. These areas must be evaluated later on a site-by-site basis.

Privately-owned now, these lands will be purchased by the City of Broomfield and Jefferson County Open Space. Broomfield already owns land adjacent to its Great Western Reservoir; this land is not part of the court action, but will receive remedial treatment, as necessary, also. Broomfield's land is within the Jefferson Soil Conservation District; the city is considering becoming a cooperator.

These recommendations are fairly general. Soil monitoring is being conducted now by Rockwell to identify specific land areas which will need the proposed remedial treatment. When this monitoring is completed, our recommendations will need to be refined to account for site-specific variables in soils, topography, and vegetation.

Our objective is to minimize wind and water erosion (and, hence, plutonium migration) during the remedial action process. Given the complex topography, the "difficult" soils, the unpredictable moisture conditions, and the strong local winds, this will not be easily achieved. With the exception of a few overgrazed, cropped or disturbed areas, the site already has a good cover of native grasses and is pretty well protected from erosion. If plowed, it may take quite some time to restore this cover. Any disturbance of these soils will promote wind and water erosion. For these reasons, from a soil management perspective, this land would be better off if left alone.

If this land MUST be disturbed to satisfy State Health Department standards, we strongly recommend that restrictions be placed on allowable future land uses. Native grass cover and low-impact open space uses will afford these lands the greatest long-term stability. Periodic grazing (or mowing) is both acceptable and desirable from a grass management standpoint, as long as good management is observed.

2

WE DO NOT RECOMMEND THE FOLLOWING:

1. seedings which rely too heavily on introduced species;
2. irrigation (except for limited use during seeding establishment or during extended drought);
3. recreational vehicle use (e.g. dirt bikes);
4. cropland uses.

Introduced grasses will not perform or persist as well as native grasses in the long run, especially during extended dry periods. Native grass species offer the best longterm protection.

We do not recommend the use of these lands for purposes requiring irrigation. There are areas of steep slopes and shallow-to-shale soils which risk too much water erosion if used for irrigated crops. Turfgrass management--for parks or golf courses--raises additional concerns. Traditional lawn irrigation management applies much more water than is necessary. In addition, turfgrass uses generally mean the utilization of various chemicals--herbicides, pesticides, soil conditioners and fertilizers--to produce a thick green carpet. We are not convinced that enough is known about the potential impacts this kind of intensive, chemically-dependent land use might have on this land.

Recreational vehicle use, obviously, risks overuse and destruction of the fragile vegetal cover.

Use as non-irrigated cropland risks too much wind and water erosion. Even with good conservation practices we cannot eliminate all erosion, and during extended dry years, it is possible to lose soil at a rate of 70 tons per acre per year . . . or more.

WE DO RECOMMEND A "COMPLETE" REVEGETATION PROGRAM:

1. spring ground preparation (May), plus a summer (June) cover crop;
2. drilling grass seed into cover crop stubble in the fall;
3. supplemental mulch;
4. timely irrigation during the establishment period;
5. weed control.

The tillage and revegetation scheme is based on spring plowing. While the fall could also provide suitable moisture and wind conditions, it does not give us enough time for adequate seedbed preparation, which is critical for a successful seeding.

Most of the land is in native grass now. Spring plowing allows time for some decomposition of the organic matter. It gives the soil time to "settle".
A forage sorghum cover crop, planted in June, protects the soil before and after the fall grass seeding and gives the opportunity to control pioneering weeds. Mulch could be used in lieu of a cover crop, and the contractor should be prepared to use it in the event of cover crop failure or localized erosion problems. Overall, the use of a cover crop is preferred because it helps make a better seedbed for the grass. Since our aim is to control erosion and expedite revegetation, this method has the best chance for success. THERE ARE NO RELIABLE SHORTCUTS.

3

REMEDIAL TREATMENT OF GRASSLANDS

EROSION CONTROL

Small land areas may be worked on all at once, but larger areas will require a phased program of remedial action. Land should be broken out in alternating strips perpendicular to the prevailing winds or, on long slopes, on the contour. Strip widths will be determined by a number of site-specific variables, including soil characteristics, slope length and gradient, vegetative cover, and field width. Work on the other set of strips will not begin until the first set is successfully reestablished in grass.

Properly done, this will minimize erosion - in "normal" weather. There should be some stand-by provisions for emergency erosion control in the event of unusual weather - extra mulching and sediment-trapping diversions, for example.

SOIL PREPARATION

Timing of tillage work is critical for successful soil management and erosion control.

Our revegetation scheme utilizes a cover corp (forage sorghum) which will be planted in June when the soil has warmed to 60°F. We don't want to leave the ground unprotected for long, and we want to avoid tillage during the windy season - normally through the end of April. This leaves May as the logical time for the plowing, disking, chiseling, and harrowing operations necessary to satisfy the soil mixing objective of the remedial action plan and to prepare a decent seedbed for the cover crop.

Wind is not the only thing we are concerned about. Soil moisture is important, too - at the surface AND at the intended plowing depth (10-12 inches.) Surface moisture is important since we do not want soil blowing while the tillage work is being done. A light irrigation the day before tillage is done may be the best way to avoid dust blowing. Care should be taken not to overwater. Soil moisture at plow depth is important because these clayey soils can easily form tillage pans when they are worked at too high a moisture content. These pans can be effective barriers to water and root penetration; they can result in increased water erosion and, on slopes, land slumping. To avoid this, tillage should be performed when the soil moisture is between 30 and 60 per cent of field capacity.

The total amount of tillage required depends on how well the mixing satisfies the plutonium concentration standard. We normally would expect the following operations to be needed: plowing, disking (2X), chiseling (1X, more if a pan has formed), harrowing (2X). This sequence should provide a satisfactory seedbed for the cover crop.

Additions of nitrogen and phosphorous are likely needed; a minimum of 50 lbs./acre each of N and P_2O_5 should be applied while the ground is being prepared for the cover crop.

NOTE: At least 1.5 tons per acre of hay or straw should be crimped into the soil at this time. This will minimize erosion until the cover crop is established. (See mulching section)

COVER CROP

Advantages of using a cover crop:

- protects the soil until grass can be seeded in the fall;
- provides opportunity to control any weed problems that materialize after ground preparation;
- leaves the soil in a firm but friable condition, well-suited for grass seeding;
- leaves a standing stubble, naturally anchored, which reduces wind damage and catches snow for extra moisture;
- helps insulate the soil from heat and conserve soil moisture.

We recommend using a hybrid, male-sterile sorghum because the sterile seed does not present a "volunteer" problem (grain which germinates and competes with the grass seed). The forage can be cut and used as a bundle feed or as a supplementary mulch.

Forage sorghum should be planted in June when the soil temperature has reached 60°F; seed 8 to 20 pounds per acre depending on the variety. Supplemental irrigation may be required to ensure a good stand. Cut at a height of 8 to 12 inches so that there are 3000 to 4000 pounds of residue left per acre.

GRASS SEEDING

Grass should be drilled into the ground after November 1, when the ground is not frozen, with a good grassland drill. A "good" grassland drill is equipped with double-disk furrow openers, depth bands (for accurate seed placement), press wheels and either a seedbox agitator or double seedbox arrangement (to facilitate accurate planting of large and small seed).

We have recommended a seeding mix (see Attachment #1) which includes two native grasses, western wheatgrass and sideoats grama, and two introduced grasses, pubescent wheatgrass and smooth brome. We have included the small amount of introduced grasses because they tend to germinate and establish themselves more quickly than the native grasses. We want early soil protection, but we do not want to compete with the native species, which are to be the longterm producers.

Grass should be seeded 3/8 to 1/2 inch deep on these soils. Tractor speed must be slow to ensure accurate planting. Seeding should stop if winds reach sustained speeds of 12 to 15 mph.

MULCH

The cover crop will, hopefully, leave plenty of residue for soil protection. If it is insufficient in some areas, mulch will be needed. There are several alternatives:

1. Long-stemmed, weed-free native grass hay
   - western wheatgrass hay would be a good choice because it's in the seeding mix
   - hay from an area like North Park is good since most of the species aren't likely to be competitive with our seed mix, especially if the hay has a lot of Nebraska sedge or Baltic rush
2. Long, clean, weed-free cereal straw (clean refers to the absence of cereal grain which can germinate and sabotage the new seeding.)
3. Hydromulch

All should be applied so that there are 3000-4000 pounds of mulch per acre, or equivalent. Hay and straw require crimping to anchor it. It should be anchored 3-4 inches deep using a crimper or a flat-plated disk.

Tacking agents can also be used to anchor mulches. There are asphalt emulsions and synthetic compounds available for this purpose.

SUPPLEMENTAL IRRIGATION

Timely light irrigations through the establishment period should be used to improve the chances for a successful planting. These soils are very clayey and slowly permeable; water should be applied by a sprinkler at a rate of no more than 1/4-1/2 inch per hour.

Irrigation will need to be carefully monitored to ensure that surface runoff is minimized and that grass root development is not impaired by overwatering.

WEED CONTROL

Weeds in the new grass seeding are best controlled by periodic mowing at a height of about six inches. Chemical weed control is possible on some weeds after the new grass has reached the four-leaf stage, but injury can still occur to the grass under some conditions . . . . so mowing is still preferred.

GRASS MANAGEMENT

There should be no grazing, haying or recreational use of newly seeded areas during the first year. It may take two years, or more, for the stand to develop to the point where it effectively covers the ground and can tolerate these uses.

Once established, a well-managed grazing program is desirable. The natives evolved under grazing pressure and become less vigorous without it (or a mowing substitute.) These guidelines should be adhered to:

- The new season's growth should not be grazed or clipped until it reaches a height of about 6-8 inches.
- Grass should not be grazed or clipped shorter than 4 inches during the growing season
- No more than 50% of a season's growth should be removed.

A complete grazing management plan should be developed for all land areas after remedial treatment is completed. Existing vegetation needs to be evaluated to ascertain species composition and seasonal production. Once this is done, other management items can be considered and stocking rates computed.

Several smaller units are better than one large one. It allows periodic deferments during a growing season, giving plants a chance to recover from grazing. It also allows a unit to be deferred for most of a growing season every few years, so that plants can mature and produce seed.

Maintenance of grass cover is of the utmost importance on these lands. Whether simple or complex, a grazing plan is essential. Details can be worked out as ownership and long-term land management objectives are firmed up.

REVEGETATION OF CROPLAND

Although cropped areas appear to be within the state plutonium concentration standard (having already undergone soil mixing), we feel these areas should be promptly revegetated.

Intensive soil preparation is not required, unless there are weed problems. If weeds are a big problem, we would recommend proceeding with the forage sorghum cover crop, as above. Weeds can be eliminated, or at least controlled during this period.

If weeds are only a problem in small areas, it may be practical to use spot treatment with chemicals or with tillage.

Existing cropland is used for winter wheat. If weeds are not a problem, it's possible to drill grass seed directly into the standing stubble after November 1. The main problem with this is the danger of losing the planting to volunteer wheat in the spring. This is especially true if the fall is dry and little volunteer is evident. However, it may be worth trying; if it doesn't work out, one can come back with the cover crop approach in June.

If the late season moisture allowed some volunteer growth, it can be killed with a contact herbicide. This doesn't guarantee there won't be a volunteer problem in the spring, but at least there may not be as much.

In some areas stubble may be too thin to provide reliable erosion control. These areas should be supplemented with mulch.

SOILS INVENTORY[1/]

Symbol	Map Unit	Capability Class (Non-irrigated)
25	Denver clay loam, 0-2 percent slopes	IIIc
26	" " " 2-5 " "	IIIe
27	" " " 5-9 " "	IVe
29	Denver-Kutch clay loams, 5-9 percent slopes	IVe
30	" " " " 9-15 " "	VIe
31	Denver-Kutch-Midway clay loams, 9-25 percent slopes	VIe
42	Englewood clay loam, 2-5 percent slopes	IIIe
60	Haverson loam, 0-3 percent slopes	IIIc
80	Leyden-Primen-Standley cobbly clay loams, 15-50 percent slopes	VIIe
97	McClave clay loam, 0-3 percent slopes	IIIw
102	Nunn clay loam, 0-2 percent slopes	IIIc
103	" " " 2-5 " "	IIIe
133	Renohill-Manzanola clay loams, 9-15 percent slopes	VIe
149	Standley-Nunn gravelly clay loams, 0-5 percent slopes	IIIe
165	Ustic Torriorthents, loamy, 15-50 percent slopes	VIIe
174	Willowman-Leyden cobbly loams, 9-30 percent slopes	VIe

[1/] Sheet numbers 1 and 3 of the Golden Area Soil Survey (USDA-SCS, Jefferson County, Colorado Agricultural Experiment Station) provide soil mapping information for these properties. The survey text contains detailed information about the individual map units, interpretations for selected land uses and general information about a variety of subjects, including capability classification.

ACREAGES OF VARIOUS SOILS INVOLVED IN THE SETTLEMENT AND ON CITY LANDS

Symbol	Acreage on Settlement Lands	Acreage on City of Broomfield Lands
25	45.9	15.6
26	133.1	11.9
27	45.0	----
29	91.9	27.5
30	3.7	----
31	7.4	46.9
42	----	10.1
60	72.6	1.8
80	74.4	----
97	5.5	7.3
102	87.2	----
103	5.5	----
133	9.2	----
149	117.4	----
165	----	3.7
174	13.8	----

The acres were calculated by planimeter; reservoirs and other bodies of water, roads, etc. were not included. Total acreage may vary from any other measurements due to minor scale variations between different maps.

Dashes indicate that particular soil was not found on the property.

ATTACHMENT #1

SEEDING RECOMMENDATION

Species	Variety[1/]	Characteristics[2/]	Percent of mix	lb. PLS[3/] per acre drilled
Western Wheatgrass (Agropyron smithii)	Arriba	N,C,S	40	6.4
Sideoats Grama (Bouteloua curtipendula)	Vaughn	N,W,B	40	3.6
Pubescent Wheatgrass (Agropyron trichophorum)	Luna	I,C,S	10	1.4
Smooth Brome (Bromus inermis)	Lincoln	I,C,S	10	1.3
		TOTALS	100%	12.7 lbs

[1/] These varieties were developed for conservation uses; they have superior vigor and production potential. They are available locally--ACCEPT NO SUBSTITUTES. We recommend that certified seed be purchased; this is a guarantee of species and varietal purity.

[2/] Characteristics: N = native; I = introduced, not indigenous to this area; C = cool season (begins growth and makes seed in spring to early summer, with some regrowth in the fall); W = warm season (begins growth and makes seed in warm summer months); S = sod former; B = bunch grass.

[3/] PLS = Pure Live Seed. This is viable seed of the right species. To find PLS in a bag or lot of seed, check the seed tag:

$$PLS = \frac{\% \text{ Purity} \times \% \text{ Germination}}{100}$$

If a bag of western wheatgrass has 90% purity and 80% germination, we have:

$$\frac{90 \times 80}{100} = 72\% \text{ PLS.}$$

If we want to seed 16 lb PLS/acre, and our PLS is 72%, we need to seed bulk seed at a rate of $\frac{16}{.72}$ = 22.2 lb/acre.

APPROXIMATE RETAIL COST (as of 4/1/85) per pound certified pure live seed

Arriba Western Wheatgrass	$4.50
Vaughn Sideoats Grama	4.80
Luna Pubescent Wheatgrass	2.15
Lincoln Smooth Brome	0.90

ESTIMATED COST OF SEED MIX

$50.26/acre

NOTE: Sometime seed dealers convince buyers to use a pre-packaged mix which is adapted to a fairly wide geographic area. These "shotgun mixes" usually have only a few well-adapted, desirable species for any given area within the zone, and several more which are not. Something usually germinates (which makes the buyer happy) but this is an expensive way of buying seed. On this project, such a mix could prove to be "costly" in terms of erosion, and public opinion, as well.

SPECIFIC RECOMMENDATIONS

FOR REMEDIAL ACTION

City of Broomfield Land
(Part of Section 7, T.2 S., R.69 W.)

MONITORING PLOTS B-2, B-3, C-2, D-1, D-2, D-3 and D-5 are to receive the proposed remedial action. There are certain areas within these plots which should not be disturbed - the drainages, steep slopes, gravelly knolls. These areas should be treated in some other way if they cannot be exempted.

We have recommended breaking out the land in alternating strips. Remedial action would not begin on the unbroken strips until the first set is reestablished in protective grass. We are recommending that two kinds of strips be used: field strips and contour strips. (See topographic map for layout information.)

Field strips are laid out "across the slope." They may deviate from the true contour by up to 1/2 the natural slope gradient. We have recommended widths of 110 ft, 120 ft and 160 ft depending on slope gradients. These figures can be adjusted about 10% to fit equipment widths.

Contour strips are laid out on the contour. They are more narrow than field strips - in this case about 80 ft. Again, there is a 10% allowance for fitting tillage equipment to them. These widths will not be the same as one goes downhill, however. Slopes are not uniform, and, because these strips are laid out strictly on the contour, they will vary in width from end-to-end and from strip-to-strip.

The contour strips are more troublesome to work on, but they are very necessary on the steep slopes and soils encountered on part of this property. (See topog. map.)

The combination of strips and irregular topography also results in "correction areas" - odd shaped areas which don't lend themselves to the strip layout. These areas are combined with an adjacent strip - and farmed across the slope as much as possible.

Wind and water erosion calculations support the use of field and contour strips. Our computations also support the use of 1.5 tons of cereal straw or hay mulch per acre on the strips - after soil mixing is completed. This is to prevent wind and water erosion while the forage sorghum cover crop is getting established.

We have provided a copy of our wind and water erosion worksheet for plots D-1, D-2, and D-3, (with explanatory notes) for your information.

The situation is not materially different on most of the other plots, except where we have recommended the contour strips. These areas are so fragile, that they require the extra protection.

There are several irregularly shaped areas next to the drainages which are not stripped. These areas should be farmed on the contour as much as possible.

12

Here's a brief look at potential erosion on the NE - facing slopes in B-2:

Alternative	Estimated Erosion (tons/acre/year) WATER	WIND	TOTAL
"Worst Condition" - No strips - No cover crop - No mulching	33-83	60	93-143
With Strips & Cover Crop - With Mulch Between Plowing & Cover Crop	1-3	nil	1-3
- Without Mulch Between Plowing & Cover Crop	4-11	9-11	13-22

U.S. Department of Agriculture
Soil Conservation Service

CO-CPA-2
11/83
(180-12-11)

ESTIMATING SOIL LOSS FROM WIND AND WATER EROSION

NAME: CITY OF BROOMFIELD ADDRESS: —— DATE: 4/85 TECHNICIAN: G FINSTAD
Legal Description: Sec: part of 7 Twp: 2 S. Range: 69 W. Rainfall "R" 70 Climatic Factor "C" 80
RESOURCE MANAGEMENT SYSTEM: "NATURAL AREA - RECREATION"
~~PRACTICE ALTERNATIVE:~~

	Practice Alternatives	B/A	Field No.	Acres	Soil Series 3/	K 4/	Slope Length 5/	% Slope	LS	C 6/	P 7/	Loss T/A/Yr.	I	K	L 8/	V 9/ ("EQUIVALENTS")	Loss T/A/Yr.	USLE	WEQ	~~Furrow~~ Erosion	Total T/A/Yr.	T 10/	Other 11/	Total Tons/Year
			SHEET & RILL EROSION 1/										WIND EROSION 2/					TOTAL EROSION FROM ALL SOURCES Tons/acre/year						
UNDISTURBED	1	B ~~A~~	PLOTS D-1, D-2, D-3	30	Denver-Kutch-Midway	.32	150'	12	2.2	.01	1.0	0.5	86	1.0	0' (sheltered)	2400 lbs.	nil	0.5	nil	X	0.5	3.3	NONE OBSERVED	0.5
"WORST CONDITION" -NO COVER CROP -NO STRIPS -NO MULCHING	2	~~B~~ A								1.0	1.0	49.3			900'	0	58.2	49.3	58.2	X	107.5		GULLYING PROBABLE	107.5 ? +
W/O FIELD STRIPS — EFFECT OF MULCH BETWEEN PLOWING & COVER CROP ESTABLISHMENT	3a w/o mulch	~~B~~ A								SEE ATTACHED EXPLANATION	1.0	16.2			900'	3300	10.1	16.2	10.1	X	26.3		GOOD CHANCE FOR GULLYING	26.3 ? +
	3b w/ mulch	~~B~~ A									1.0	4.2			900'	3800	nil	4.2	nil	X	4.2			4.2 ? +
W/ FIELD STRIPS — EFFECT OF MULCH BETWEEN PLOWING & COVER CROP EMERGENCE	4a w/o mulch	~~B~~ A									.5	8.1			160'	3300	6.0	8.1	6.0	X	14.1		GULLYING UNLIKELY	14.1
	4b w/mulch	~~B~~ A									.5	2.1			160'	3800	nil	2.1	nil	X	2.1			2.1 ✓
W/ STRIPS, BUT: -NO COVER CROP -NO MULCH	5	~~B~~ A								1.0	.5	24.6			160'	0	34.7	24.6	34.7	X	59.3			59.3
		B A																						
		B A																						

B - BEFORE
A - AFTER

1/ Agronomy Technical Note "50
2/ Agronomy Technical Note "53
~~3/ Agronomy Technical Note "53~~
~~4/ Agronomy Technical Note "51~~

14

FOOTNOTES TO WIND & WATER EROSION WORKSHEET (CO-CPA-2)

1/ Water erosion is estimated by using the Universal Soil Loss Equation (USLE). This provides an estimate of sheet and rill water erosion, but not concentrated flow (gully) erosion.

The formula is A = RKLSCP

A = predicted annual soil loss (tons/acre/year)
R = rainfall and runoff factor
K = soil erodibility factor
L = effective slope length } combined into LS factor
S = slope gradient }
C = soil cover and management factor
P = erosion control practice factor

"A" is determined by multiplying the other factors together.

2/ Wind erosion is estimated by using the formula E = f(IKCLV)

E = predicted annual soil loss (tons/acre/year)
I = soil erodibility factor
K = soil ridge roughness factor
C = climatic factor
L = unsheltered distance across a field in prevailing wind direction
V = vegetative cover (quantity, kind, orientation)

"E" cannot be computed directly by multiplication of the variables. Instead, one must consult technical references which have tables generated from research.

3/ A "soil complex" is mapped for this site. The soils are so intermingled it was not practical to separate them. The soils are mapped as: Denver-Kutch-Midway clay loams, 9 to 25 percent slopes.

Denver (and inclusions with similar properties) comprise about 50% of the area; Kutch makes up 30%; Midway, 20%. We have computed average K and T values (soil erodibility and allowable annual soil loss, respectively) for the complex to make planning easier.

4/ K values

SOIL	K	%
Denver (and inclusions)	.28	50
Kutch	.32	30
Midway	.43	20

Weighted Average: 0.32

5/ Slope length is difficult to determine accurately, especially on this site and under good grass cover. We have used 150 feet, which is a reasonable estimate. There are shorter slopes towards the east, but there are longer, more complex slopes towards the west.

6/ C values reflect cropping and soil management influences on the soil erosion process. A value of 0.01 indicates very low erosion potential; 1.0 is bare ground.

7/ The P factor is 1.0 if farming operations are done up & down the hill or if the land is covered by grass or trees. Contouring and stripcropping reduce the P value, depending on slope gradients, because they tend to slow runoff and reduce erosion. There are limits to the effectiveness of these practices, however, and, if used incorrectly, can actually worsen a situation by concentrating runoff.

8/ "L" is the unsheltered distance across a field in the direction of the prevailing winds. The grassland is currently under good grass cover and is considered "sheltered" - therefore, L = 0. The prevailing wind direction is assumed to be from the northwest. Our recommended 110 ft. wide field strips measure about 160 ft. along the NW/SE angle.

9/ Instead of V values, I have converted them to "flat, small grain stubble equivalents" which makes computations and comparisons much easier.

In Practice Alternative (PA) #1, 2400 lbs. = 1000 lbs. annual grass production.

In PA's 3a and 4a, 3300 lbs. = 2 tons of standing forage sorghum stubble with some litter in-between the rows.

In PA's 3b and 4b, 3800 lbs. = 1.5 tons of hay or straw mulch (applied before the cover crop seeding.)

10/ T = allowable annual soil loss . . . for agricultural situations. On this project, there probably isn't any allowable soil loss, so the weighted average has little real significance.

SOIL	T	%
Denver (and inclusions)	5	50
Kutch	2	30
Midway	1	20

Weighted average = 3.3 tons/acre/year.

11/ Other erosion (concentrated flow erosion, gullying, etc.) This is not a problem on the site now, but has great potential to become one if the land is not adequately protected during the remedial action process.

EXPLANATION OF CALCULATIONS
FOR
PRACTICE ALTERNATIVES 3a, 3b, 4a & 4b

Use of averaged values for the planning year can result in misleading erosion estimates. In order to more accurately reflect the water and wind erosion potential during short, but critical, periods of time in the remedial action process, we have adjusted some of the erosion factors for the following time periods:

A - from spring plowing to cover crop emergence (approx. May 15 - June 15)

B - from cover crop emergence to "effective" ground cover of the sorghum canopy (approx. June 15 - July 15)

C - from "effective cover" to sorghum maturity (approx. July 15 - August 15)

D - the remainder of the planning year (August 15 - the next May 15)

The value of protective mulch between ground preparation and cover crop emergence becomes very apparent - for both water and wind erosion control.

To accomplish this partial year analysis requires use of adjusted "R" values (for water erosion) and a factor to reflect wind erosion potential distribution for part of a year.

Approximately 17.4% of the annual wind erosion potential occurs between May 15 and July 1. If mulch is not used before the cover crop establishment, we can expect about 17.4% of a year's wind erosion to occur. The soil loss figures in the worksheet reflect this percentage.

Shown below are the calculations for estimated water erosion - with & without mulch before the cover crop and with & without field strips.

A = RKLSCP (K = .32; LS = 2.2; K(LS) = .704)

		Time Period		Adjusted "R"		K(LS)		"C" Value		Soil Loss (tons/ac./yr.)	
Without Strips (P = 1.0)	Without Mulch	A	X	17	X	.704	X	1.00	=	12.0	Total: 16.2
		B	X	17	X	.704	X	.20	=	2.4	
		C	X	12	X	.704	X	.10	=	0.8	
		D	X	24	X	.704	X	.06	=	1.0	
	With Mulch	A	X	17	X	.704	X	.10	=	1.2	Total: 4.2
		B	X	17	X	.704	X	.10	=	1.2	
		C & D same as above									

With Strips (P = 0.5) Without Mulch: above figures X 0.5 ; total = 8.1 T/Ac/Yr.

With Mulch: above figures X 0.5 ; total = 2.1 T/Ac/Yr.

17/17